Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given by Mr. Suresh Patel during a telephone interview on April 14, 2010.

The application has been amended as follows:

Replace the title with the following:

-- Method and Apparatus for Parallel Loadflow Computation for Electrical Power System --

Replace the abstract with the following:

-- Gauss-Seidel-Patel Loadflow (GSPL) loadflow calculation method is invented involving self-iteration over a node within global iteration over (n-1) nodes in n-node power network. Also invented is a network decomposition technique referred to as Suresh's diakoptics that determines a sub-network for each node involving directly connected nodes referred to as level-1 nodes and their directly connected nodes referred to as level-2 nodes, wherein the level of outward connectivity for local solution of a sub-network around a given node is to be determined experimentally. Sub-networks are solved in parallel, and local solution of sub networks are related into network wide

global solution using an invented technique. These led to the invention of the best possible parallel computer - a server-processor parallel-processors architecture wherein each of the parallel processors communicate only with the server processor, commonly shared memory locations, and each processor's private memory locations but not among themselves. --

In specification:

Paragraph 0035, line 1, before "flow-chart", insert – prior art --.

Paragraph 0036, line 1, before "flow-chart", insert – prior art --.

Paragraph 0037, line 1, before "one-line", insert – prior art --.

In the Drawings (please see attached proposed drawing changes):

Sheets 1-14, insert label – Replacement Sheet --.

Figs. 1A (second page), 1B (second page), 3A (second page), and 3B (second page), insert – (Cont.) --.

Figs. 5-7, insert label – Prior Art --.

Replace claim 28 with the following:

-- 28. (Currently Amended): A method of forming/defining and solving a model of a power network to affect control of voltages and power flows in a power system, comprising the steps of:

obtaining on-line/simulated data of open/close status of switches and circuit breakers in ~~a~~ the power network, and reading data of operating limits of components of ~~a~~ the power network including PV-node, a generator-node where Real-Power-P and Voltage-Magnitude-V are given/assigned/specified/set, maximum and minimum reactive power generation capability limits of generators, and transformers tap position limits,

obtaining on-line readings of given/assigned/specified/set ~~real-power-P~~ Real-Power-P and ~~reactive- power-Q~~ Reactive-Power-Q at PQ-nodes, ~~the nodes where Real-Power-P and Reactive-Power-Q are given/assigned/specified/set,~~ ~~real-power-P~~ Real-Power-P and voltage-magnitude-V at PV-nodes, voltage magnitude and angle at ~~the~~ a reference/slack node, and transformer turns ratios, ~~which~~ wherein said on-line readings are the controlled variables/parameters,

initiating loadflow computation with initial approximate/guess solution of the same voltage magnitude and angle as those of the reference/slack node for all the ~~other~~ PQ-nodes and the PV-nodes, said initial approximate/guess solution is referred to as a slack-start,

performing loadflow computation to calculate complex voltages or their real and imaginary components or voltage magnitude corrections and voltage angle corrections at nodes of ~~a~~ the power network providing for calculation of power flow through different components of ~~a~~ the power network, and to calculate reactive power generation and transformer tap-position indications,

decomposing ~~a~~ the power network for performing said loadflow computation in parallel by a method referred to as Suresh's diakoptics that involves determining a sub-

network for each node involving directly connected nodes referred to as level-1 nodes and directly connected nodes to level-1 nodes referred to as level-2 nodes, and a level of outward connectivity for local solution of a sub-power-network around a given node is determined experimentally,

initializing, at the beginning of each new iteration, a vector of dimension equal to the number of nodes in ~~a~~ the power network with each element value zero,

solving all sub-networks in parallel using available solution estimate at the start of the iteration,

adding newly calculated solution estimates or corrections to the available solution estimate for a node resulting from different sub-networks, 'q' number of sub-networks, in which a node is contained, in a corresponding vector element that gets initialized zero at the beginning of each new iteration,

counting the number of additions and calculating new solution estimate or corrections to the available solution estimate by taking the average or root mean square value using any relevant relations (30) to (39) in the following depending on the loadflow computation method used, and

storing the new solution estimate at the end of the current iteration as initial available estimate for the next iteration,

wherein said Suresh's diakoptics method uses the following relations,

$$V_p^{(r+1)} = (V_{p1}^{(r+1)} + V_{p2}^{(r+1)} + V_{p3}^{(r+1)} + \ldots + V_{pq}^{(r+1)})/q \quad (30)$$

$$\Delta\theta_p^{(r+1)} = (\Delta\theta_{p1}^{(r+1)} + \Delta\theta_{p2}^{(r+1)} + \Delta\theta_{p3}^{(r+1)} + \ldots + \Delta\theta_{pq}^{(r+1)})/q \quad (31)$$

$$\Delta V_p^{(r+1)} = (\Delta V_{p1}^{(r+1)} + \Delta V_{p2}^{(r+1)} + \Delta V_{p3}^{(r+1)} + \ldots + \Delta V_{pq}^{(r+1)})/q \quad (32)$$

$$e_p^{(r+1)} = (e_{p1}^{(r+1)} + e_{p2}^{(r+1)} + e_{p3}^{(r+1)} + \ldots + e_{pq}^{(r+1)})/q \qquad (33)$$

$$f_p^{(r+1)} = (f_{p1}^{(r+1)} + f_{p2}^{(r+1)} + f_{p3}^{(r+1)} + \ldots + f_{pq}^{(r+1)})/q \qquad (34)$$

wherein relations (30) to (34), can also alternatively be written as relations (35) to (39) as below,

$$V_p^{(r+1)} = \sqrt{(Re((V_{p1}^{(r+1)})^2) + Re((V_{p2}^{(r+1)})^2) + \ldots + Re((V_{pq}^{(r+1)})^2)/q} + j\sqrt{(Im((V_{p1}^{(r+1)})^2) + Im((V_{p2}^{(r+1)})^2) + \ldots + Im((V_{pq}^{(r+1)})^2))/q} \qquad (35)$$

$$\Delta\theta_p^{(r+1)} = \sqrt{(\Delta\theta_{p1}^{(r+1)})^2 + (\Delta\theta_{p2}^{(r+1)})^2 + \ldots + (\Delta\theta_{pq}^{(r+1)})^2)/q} \qquad (36)$$

$$\Delta V_p^{(r+1)} = \sqrt{(\Delta V_{p1}^{(r+1)})^2 + (\Delta V_{p2}^{(r+1)})^2 + \ldots + (\Delta V_{pq}^{(r+1)})^2)/q} \qquad (37)$$

$$e_p^{(r+1)} = \sqrt{((e_{p1}^{(r+1)})^2 + (e_{p2}^{(r+1)})^2 + \ldots + (e_{pq}^{(r+1)})^2)/q} \qquad (38)$$

$$f_p^{(r+1)} = \sqrt{((f_{p1}^{(r+1)})^2 + (f_{p2}^{(r+1)})^2 + \ldots + (f_{pq}^{(r+1)})^2)/q} \qquad (39)$$

wherein, square of any positive or negative number being positive, if the original not-squared value of any number is negative, the same algebraic sign is attached after squaring that number, and if the mean of squared values turns out to be a negative number, negative sign is attached after taking the square root of the unsigned number, V_p, θ_p are voltage magnitude and voltage angle at node-p, e_p and f_p are the real and imaginary parts of the complex voltage V_p of node-p, symbol Δ before any of defined electrical quantities defines the change in the value of electrical quantity, and superscript 'r' indicates the iteration count,

evaluating loadflow computation for any ~~of the~~ over loaded components of ~~a~~ the power network and for under/over voltage at any of the nodes of ~~a~~ the power network,

correcting one or more controlled parameters and repeating the performing loadflow computation by decomposing, initializing, solving, adding, counting, storing, ~~and~~ evaluating, and correcting steps until evaluating step finds no over loaded components and no under/over voltages in ~~a~~ the power network, and

affecting a change in power flow through components ~~a~~ of the power network and voltage magnitudes and angles at the nodes of ~~a~~ the power network by actually implementing the finally obtained values of controlled variables/parameters after evaluating step finds a good power system or alternatively ~~a~~ the power network without any overloaded components and under/over voltages, which finally obtained controlled variables/parameters however are stored ~~in case of simulation~~ for acting upon fast in case ~~the~~ a simulated event actually occurs. –

Cancel claims 31-36.

Add new claim 37 as follows:

-- 37. (New) A multiprocessor computing apparatus for performing the said parallel loadflow computation as defined in claim 28 comprising in combination:

a plurality of processing units adapted to receive and process data, instructions and control signals, and connected to common system bus in parallel asynchronous fashion;

a plurality of local private main memory means for storing the data, instructions and control signals, each said main memory means being directly and asynchronously connected to each said processing unit;

common shared memory coupled directly to said common system bus for sending/receiving the data, instructions and control signals asynchronously to/from each said processing unit, without providing inter-processor communications;

I/O adapter/control unit coupled directly and asynchronously to a main/server processor, which is one of the said plurality of processing units;

wherein said I/O adapter/control unit coupled directly and asynchronously to each of said plurality of processing units physically located at far distances in case of said multiprocessor computing apparatus organized for distributed processing. --

Reasons For Allowance

The following is an examiner's statement of reasons for allowance:

The **combination** as claimed wherein a method of forming/defining and solving a model of a power network to affect control of voltages and power flows in a power system comprising decomposing the power network for performing said loadflow computation in parallel by a method referred to as Suresh's diakoptics that involves determining a sub-network for each node involving directly connected nodes referred to as level-1 nodes and directly connected nodes to level-1 nodes referred to as level-2 nodes, and a level of outward connectivity for local solution of a sub-power-network

around a given node is determined experimentally, and counting the number of additions and calculating new solution estimate or corrections to the available solution estimate by taking the average or root mean square value using any relevant claimed relations, wherein said Suresh's diakoptics method uses the claimed relations (claim 28) is not disclosed, suggested, or made obvious by the prior art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Patel (CA 2107388) discloses novel versions of decoupled loadflow methods involving computation of angle correction and updating for PV-nodes and voltage magnitude corrections at PQ-nodes (page 1).

Patel (WO 2004/023622) discloses loadflow computations in real-time operation/control and in on-line/off-line studies of electrical power systems (Abstract).

However, these two references do not disclose at least decomposing the power network for performing said loadflow computation in parallel by a method referred to as Suresh's diakoptics that uses the claimed relations.

Contact Information

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Michael P Nghiem whose telephone number is (571) 272-2277. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on (571) 272-2312. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Michael P. Nghiem/

Primary Examiner, GAU 2863

April 14, 2010